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Hot-Plug Disk Drive Removal and Replacement Guidelines for Compaq Smart Array Controllers

Abstract: *The purpose of this paper is to communicate to customers the guidelines for implementing hot-plug removal and replacement of hard drives when using Compaq Smart Array Controllers.*

Compaq is fully committed to providing the ideal client/server high availability solution for customers. High availability features in Compaq Smart Array Controllers include hot-pluggable hard drives. With hot-pluggable hard drives, customers can remove and replace one or several drives within a server while the system is online for rapid recovery while minimizing interruption of the network.

In order to maximize high availability, Compaq has issued customer guidelines on extending and implementing the removal and replacement of hot-pluggable hard drives.

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Hot-Plug Disk Drive Removal and Replacement Guidelines for Compaq Smart Array Controllers
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Rapid Recovery with Hot-Plug Drives[1]

Compaq is the clear leader in high availability rapid recovery solutions. With Compaq Pre-Failure Warranty, system administrators can proactively schedule downtime for maintenance and not interrupt critical business operations that rely on these enterprise servers. In addition, with bot-pluggable drives attacbed to Compaq Smart Array controllers, customers can remove and replace one or several drives within a server while the system is online, which minimizes the interruption of the network. To ensure maximum availability, however, Compaq recommends that customers follow the guidelines listed below in removing and replacing hot-plug drives in Smart Array controllers:

For customers who are utilizing Compaq Smart Array Controllers:[2]

Note: User intervention is required if customers are not utilizing an intelligent array controller

Definitions:

Drive Array – A drive array is a physical grouping of up to 56 physical drives (members) per array.

Logical drive – A logical drive is all of or a portion of an array with RAID 0, 1 (and derivative 0+1), 4, and 5 striping all drives of an array.

Fault tolerant RAID – All logical drives in an array must be configured with some sort of fault tolerant RAID (1, 0+1, 4, or 5). Hot-plugging a member of an array with any logical drive configured for RAID 0 will result in the loss of data on that logical drive.

Hot-Plugging –Hot-Plugging a disk drive is defined as physically removing a disk drive from the storage enclosure while powered up and online.

Guidelines when hot-plugging a drive

Customers should be able to hot-plug a drive during normal activity. It should be understood, however, that bot-plugging a disk drive will affect system performance and fault tolerance.

IMPORTANT: It is therefore recommended that disk drive replacement be performed during low activity periods whenever possible. In addition, a current valid backup should be available of the logical drives in the array of the drive being replaced, even if drive replacement is being made during server downtime.

When a disk drive is hot-plugged, although the system is functionally operational, the disk subsystem may no longer be fault tolerant. Fault tolerance **will** be lost until the removed drive is subsequently replaced **and** the rebuild operation is completed. (This will take several hours even if the system is not busy while the rebuild is in progress). If another drive in the array should incur an error during the period when fault tolerance is unavailable, it is possible to cause a fatal system error due to a data error. If another drive fails during this period, the entire contents of the array will be lost.

[1] Certain restrictions and exclusions apply. Requires that servers use Compaq Insight Manager in order to implement Pre-Failure alerting.

[2] **CAUTION:** Not following these recommended guidelines can result in data loss.

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Note: Therefore, Compaq recommends that disk drive replacement should be performed during low activity periods whenever possible. In addition, a current valid backup should be available of the logical drives in the array of the drive being replaced, even if drive replacement is being made during server downtime.

Guidelines when Insight Manager indicates that a drive is degraded and should be replaced

EXAMPLE: Using one hot-plug replacement example, a system administrator for a large business uses Compaq Smart Array Controllers on his servers. Compaq Insight Manager has indicated that a drive is degraded and should be replaced under the Pre-Failure Warranty. The system administrator should follow the guidelines outlined below for maximum availability on his server:

- All physical drives in the affected array should be present and have the online LED Indicators illuminated before removing the degraded hot-plug drive. If any online LED Indicators are flashing (indicating a rebuild) or not illuminated, the degraded drive should not be hot-plugged.

For step-by-step instructions on hot-plugging your hard drive, refer to the ProLiant Setup and Installation Guide.

- If fault-tolerance is currently being used to recover from errors from other drives in the array (such as media errors or signal-integrity errors), loss of fault-tolerance following a drive removal may result in unrecoverable errors being reported to the host operating system or failure of the entire array. To verify that such errors are not presently occurring, and before removing the degraded drive, consider using Insight Manager to examine the error counters recorded for each physical drive in the array.
- The customer must follow Compaq cabling guidelines when configuring an array to implement the best possible cabling solution for his server.
- The customer should cbeck for cabling configurations that are not supported. Signal integrity errors may be injected into the SCSI bus when an active drive is hot-plugged.
- The customer should make sure fault tolerance is not currently being used to recover from errors to other drives in the array, such as media errors or signal integrity errors. Loss of fault tolerance following a drive replacement may result in problems.
- If the customer is upgrading to larger drives in the array, follow the previously stated rules and ensure that each drive has completed its rebuild before adding the next new drive to the array.

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Table 1 shows hot-plug hard drive LED indicator status combinations.

Table 1
Hot-Plug Hard Drive LED Indicator Status Combinations

Activity	Online	Fault	Means
On	Off	Off	**Do not remove the drive. Removing a drive during this process will cause data loss.** The drive is being accessed and is not configured as part of an array.
On	Flashing	Off	**Do not remove the drive. Removing a drive during this process will cause data loss.** The drive is rebuilding or undergoing capacity expansion.
Flashing	Flashing	Flashing	**Do not remove the drive. Removing a drive during this process will cause data loss.** The drive is part of an array being selected by the Array Configuration Utility. -Or- The Options ROMPaq is upgrading the drive.
Off	Off	Off	OK to replace the drive online if a predictive failure alert is received (see the following section for details) and the drive is attached to an array controller. The drive is not configured as part of an array. -Or- If this drive is part of an array, then a powered-on controller is not accessing the drive. -Or- The drive is configured as an online spare.

CAUTION: In extreme cases, when the number of errors is greater than the firmware error recovery is able to sustain, hot-plugging on an online drive may cause some unrecoverable errors to be reported to the operating system or may cause a complete failure of the array. Refer to your operating system documentation for more information on implications, as well as possible recovery options.

IMPORTANT: Before replacing a degraded drive, use Compaq Insight Manager to examine the error counters recorded for each physical drive in the array to verify that such errors are not presently occurring.

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The system administrator should also be aware of the following Compaq guidelines cautioning unsafe hot-plug replacement:

- Do not remove a degraded drive if any other member of the array is off-line (the online LED indicator is off). No other drive in the array can be hot-plugged without data loss with the possible exception of utilizing RAID 0+1 as a fault tolerant form.

  Refer to your Smart Array Controller's user guide for information on fault tolerance options.

- Do not remove a degraded drive if any member of an array is missing (previously removed and not yet replaced).

- Do not remove a degraded drive if any member of an array is being rebuilt unless the drive being rebuilt has been configured as an online spare. The drive's online LED indicators will be flashing, indicating that a replaced drive is being rebuilt from data stored on the other drives.

Note: An online spare will not activate and start rebuilding after a predictive failure alert, as the degraded drive is still online. The online spare only activates after a drive in the array has failed.

- Do not replace multiple degraded drives at the same time (for example, when the system is off), since the fault-tolerance may be compromised. When a drive is replaced, the controller uses data from the other drives in the array to reconstruct data on the replacement drive. If more than one drive is removed, a complete data set is not available to reconstruct data on the replacement drive(s) and permanent data loss could occur.

CAUTION: Do not turn off an attached disk enclosure when the server containing the Smart Array Controller is powered on. Also, do not turn on the server before turning on the disk enclosure. If these ordering rules are not followed, the Smart Array Controller may mark these external drives as "failed," which could result in permanent data loss.

Conclusion

Compaq provides superior rapid recovery features in its Compaq Smart Array Controllers that include hot-pluggable hard drives for bigh availability. In order to achieve maximum availability, bowever, customers should follow the recommended Compaq guidelines for removal and replacement.

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